ASTIGMATISM.

Illustrative Cases from Clinical Memoranda.

READ BEFORE THE OHIO STATE MEDICAL SOCIETY,
JUNE 18, 1875.

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The term astigmatism "is a compound Greekword, derived from *a*, and stigma from *stigo*, and signifies that rays divided from one point do not again unite into one point."* The subject has been divided into regular and irregular astigmatism. When the acuteness of vision is not materially diminished by astigmatism, it is said to be normal, and abnormal when vision is much distorted by it. Regular astigmatism exists, to some degree, in almost all normal eyes. This fact any one may determine by noting the farthest point at which fine vertical lines and hori-

*Mackenzie: A Practical Treatise on Diseases of the Eye, 1854, p. 927.

zontal lines may be acutely seen. The majority of persons having normal eyes, will find that they can plainly discern vertical lines at a greater distance than horizontal lines. Donders† explains this by stating that rays emanating from vertical lines, which strike the vertical meridian of the eye, are more speedily brought to a focus than those of equal divergence situated in a horizontal plane. He further says, that the cause of regular astigmatism is to be sought partly in the cornea. "Numerous experiments have shown that the cornea, in its several meridians, has a different radius of curvature. It is thus established in the first place, that the cornea, on account of its form, produces astigmatism; in the second place, that even if the crystalline lens has an influence, the direction given to it by the cornea, in general preponderates."

Irregular Astigmatism.—Irregular astigmatism has been also divided into normal and abnormal.

The normal form has been proved to be due to the structure of the crystalline lens, by the fact that when the lens is absent from the eye, all phenomena of irregular astigmatism are removed. The abnormal degrees, on the contrary, which considerably disturb the power of vision, may depend upon irregularities of the cornea as well as upon those of the lens.

We can not precisely draw the line of demarcation between normal and abnormal astigmatism, but may consider it abnormal whenever the disturbance of vision is sufficient to attract the attention of the person affected, or whenever upon trial, the patient, from this cause, is unable to read No. 20 of Snellen's test type at twenty feet. Donders had fixed the standard for the commencement of abnormal astigmatism whenever the degree was one-fortieth; he, however, found that a cylindrical glass of one-eightieth, held before his own eyes, materially improved the distinctness of images.

The importance of this subject may be better appreciated when it is understood that, according to the most eminent authority, "in every forty or fifty eyes, one is, in consequence of astigmatism, disturbed in its functions" (Donders). And in high degrees of the affection, vision, unless assisted by proper glasses, may become comparatively useless for all the practical duties of life. It is no less remarkable than humiliating to us, as specialists, when we consider the number of eyes that were either maltreated or left in

†Donders upon Accommodation and Refraction of the Eye.

partial darkness, without treatment at all, through the many long years which intervened from the first discovery of this anomaly of refraction and its full and complete discription, practical demonstration, and general recognition by several of the eminent oculists of Europe more particularly by the eminent scientist, physiologist, and oculist, Prof. Donders, of Utrecht. In this connection it may not be uninteresting to this society to briefly trace the history of astigmatism. It is a curious fact that while we are so largely indebted to the Dutch and German oculists for the thorough and exhaustive investigations into the cause of astigmatism, the honor of its discovery is due to Thomas Young, M.R.F.C.S., who first observed the defect in his own eye, and described it in his "Philosophical Transactions for 1793." He communicated his discovery to the optician Cary, who stated that he often found that near-sighted people distinguish objects much more acutely when the glasses suited to them were held in a particularly oblique direction before the eye; by this means a part of the astigmatism may be corrected. Young sought the source of the astigmatism in the crystalline lens, and from experiments supposed it to be due to an oblique position of the lens.*

The next case of astigmatism recorded, was by Airy, in 1827, thirty-four years after Young. He detected a high degree of myopic astigmatism in his own eye; he also determined the proper glass for its correction.

Next came Stokes, who invented an astigmatic lens for determining the degree of astigmatism,

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*The brilliant discovery of Dr. Young will, I hope, excuse some slight sketch of his life at this point. He was a remarkable man; from youth until his death he was a devoted student of natural philosophy. He was born in 1773; studied medicine in 1792; in 1800 he became a member of the College of Physicians, and settled in London, where he began to practice. In 1801 he was appointed a professor of natural philosophy in the Royal Institution. He was not popular as a lecturer; his style being too condensed, and the matter of his lectures unsuited to the miscellaneous audiences of the Royal Institute. He was not more fortunate in pleasing patients; for it is recorded of him that his efforts to secure them were a failure. (Patients then, as now, were often misled by the showy allurements of quacks and pretenders.) His most valuable paper was probable upon the discovery of the law of interference of light. He was elected a fellow of the College of Physicians, also physician to St. George's Hospital. "He was the first to suggest the mode of investigation, by which the received interpretation of hieroglyphics has been arrived at."—*Circle of the Sciences.*

In 1847 a case was reported by Hamilton, and in 1848 a few cases were published by Dr. Goode.

Three cases of this anomaly are reported by Hays in his edition of Lawrence on Diseases of the Eye, 1854, page 669.

Donders quotes the above cases in detail, and says that only one more had been recorded (up to that time), which was observed upon the Continent of Europe. It was described by Pastor Schneider, of Switzerland, Canton of Lucerne, who discovered this anomaly in his own person. He was near-sighted for vertical, and far-sighted for horizontal lines; he used bi-convex cylindrical glasses combined with bi-concave spherical, for correction. Up to this time, the source of this defect in normal refraction had not been determined. "Young presumed it to be in the lens; Airy did not publish any opinion as to its seat." Wharton Jones, in his second American edition of Ophthalmic Medicine and Surgery, under the head of the cylindrical eye, mentions Airy's case as an exaggerated degree of the natural form of the cornea, so as to disturb vision.

Wilde, of Dublin, is quoted by Donders as having attributed the cause of astigmatism to be due to the form of the cornea, and he supposed that both Jones and Wilde obtained their information from a small work upon the form of the cornea, published by Gearson, at Gottengen, in 1810.

This brings the history of this anomaly of refraction up to the time of the investigations of Listing and Helmholtz, upon the physiology of vision, but to Prof. Donders is due the honor of calling general attention to the subject, among the eye-specialists of Europe and America. His masterly work upon the accommodation and refraction of the eye, was translated into English, in 1864, by request of the New Sydenham Society. To this work I am indebted mainly for the facts contained in this brief sketch of the history of astigmatism, which I have taken the liberty of introducing into this paper, believing that it would interest this society as it has me to trace the gradual development of our knowledge of the source of one of the most important defects in normal vision.

Astigmatism is frequently congenital, but slight degrees of it may not disturb vision sufficiently to be remarked, until the person affected reaches the age of thirty or forty years. When the power of the eye to accommodate itself to near and distant points becomes weakened, then the astigmatic begins to observe a diminution of clearness of vision, and to notice that the eye becomes easily fatigued by reading or writing. This is markedly the case if such

work is done by a bad light. Good illumination I have found to be a great relief to such persons.

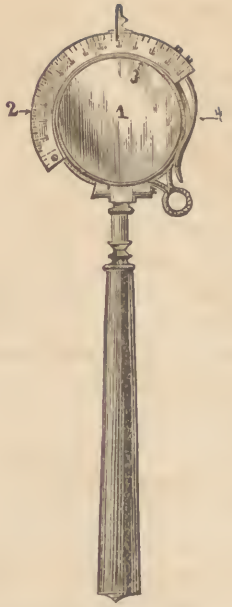
If the astigmatism be of high degree, it manifests disturbance of vision, and distortion of objects at an early age. If sex has any influence, the preponderance of this defect is to be found in males.

All cases of astigmatism have, in one or both of the chief meridians of the eye affected, either myopia (near-sight)—*i. e.* rays from distant objects (parallel rays) are focused in front of the retina—or hypermetropia (far-sight), *i. e.* divergent rays (rays from near objects), if projected, would come to a focus behind the retina. If the refractive power in one meridian only is abnormal, we have a case of simple astigmatism, which will require for correction a concave cylindrical glass, if the abnormal refraction be myopic, or a convex cylindrical lens if it be hypermetropic. If it be a case of compound astigmatism, it requires a spherical and a cylindrical lens combined, and these glasses will be either negative (concave), or positive (convex), accordingly as the astigmatism is either myopic or hypermetropic.

In the treatment of mixed astigmatism, a convex and a concave cylindrical lens are combined, their axis being at right angles.

A cylindrical lens differs from the ordinary spherical glasses in this way: The former is a segment of a cylinder, and refracts the rays of light which pass through it in a plane at right angles to the axis of the glass, and those rays which pass through its axis are not bent, but pass on in straight lines to the eye, while the spherical glasses refract equally the rays which strike any part of its surface.

For holding the trial glasses when testing for astigmatism, perhaps Nachet spectacle frames are best; but as they are only suited for glasses with frames, and moreover are not easily procured in this country, I have had constructed by the skillful surgical instrument-maker, Mr. Autenrieth, No. 71 West Sixth street, Cincinnati, an apparatus to which any of the glasses contained in trial cases can be easily adapted. As only one eye can be tested at a time, it is intended to be held by its handle, either by the patient or physician; by this means much greater facility in changing the lenses is obtained over Nachet or the German frames which have to be removed from the head in changing the glasses. With my apparatus, also, the patient is not disturbed by the weight and discomfort of which many patients, particularly ladies, complain in



1. Cylindrical lens.
2. Scale for marking angle,
3. Groove for spherical glass.
4. Spring for holding glasses.

wearing the Nachet frames. Another point of advantage is the marking of the degrees, the inner numbers correspond with those upon the Nachet frame, while the outer mark the angle when at the vertical point at which the axis of the glass must be set in spectacle frames by the optician. As in the Nachet apparatus, the cylindrical glass may be turned before the eye to any angle, the inner circle may hold at the same time a spherical glass. It is important before taking the angle, that the handle of the instrument be perpendicular to the horizontal meridian of the eye.

Methods of determining astigmatism.—These are too numerous to mention in detail here; but for practical purposes, the plates of Becker or Snellen are sufficient. The former consist of short bars or stripes, arranged three in a group, in a circle, having three horizontal bars in the center. See Snellen's plate, which must be placed at a distance of fifteen to twenty feet from the eye for testing purposes.

Dr. Green's plates* are recommended by Solberg Wells. They embrace the principle given in the plates of Becker and Snellen. Either of these plates have numbers at the top of each bar or stripe which marks the angle. If all the lines are distinct and sharply defined, the eye is not astigmatic; but if one or more lines in one meridian are distinct, and the other dim, astigmatism is proved, and the direction of the line most distinct corresponds to the meridian of the highest refraction. Furnished with a case of trial glasses, we find the weakest concave or strongest convex cylindrical lens which causes all the stripes to be equally bright and distinct. This is generally the correct glass. In compound astigmatism the excess of myopia or hypermetropia must first be neutralized by the proper spherical glass, before adjusting the cylindrical lens.

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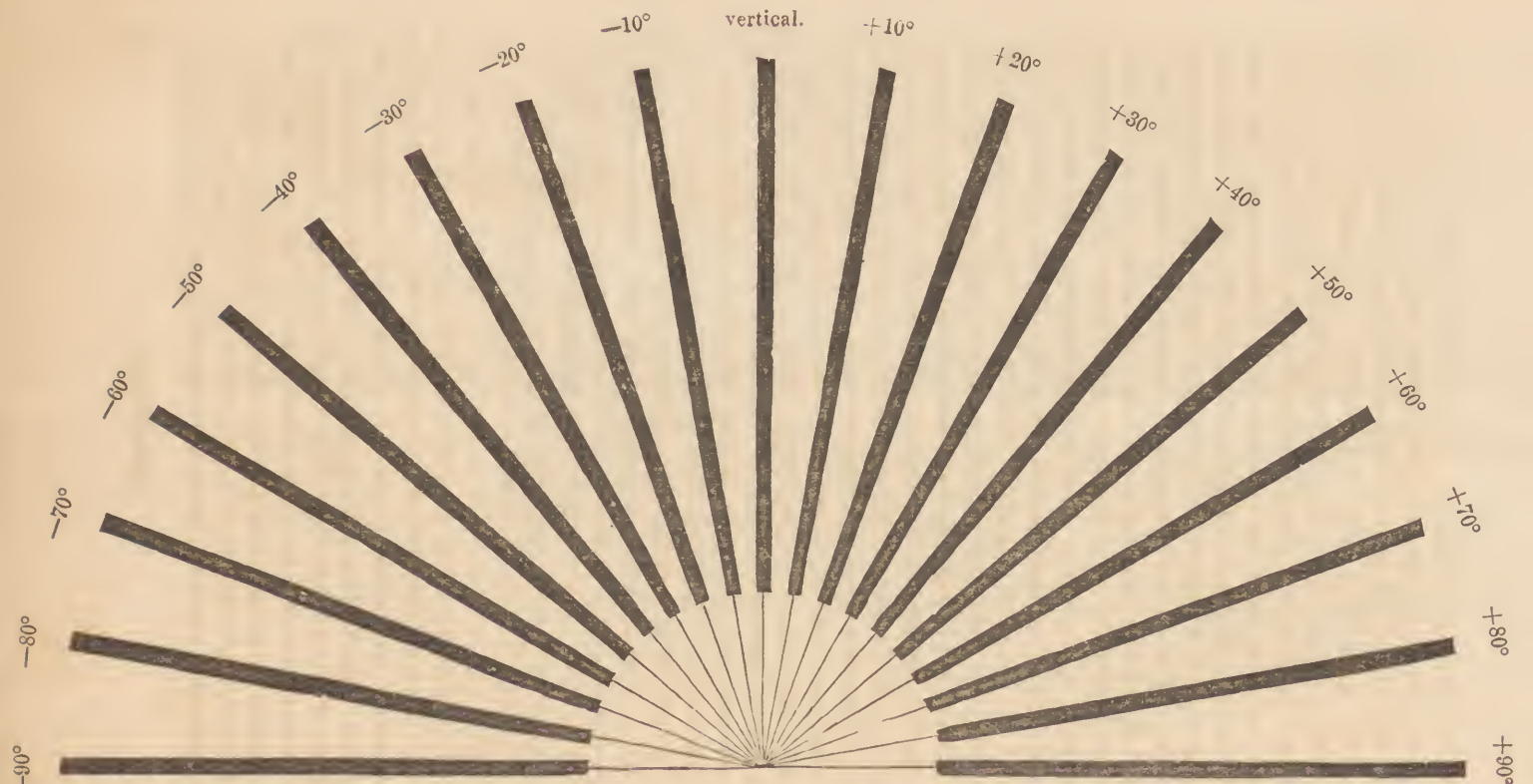
* Dr. Green, of St. Louis, Mo.



Test-circle, for determining the direction of the principal meridians of astigmatism; the maximum and minimum of curvature. (Snellen.)

Ordinarily, this method is sufficient to arrive at the degree of astigmatism, and the proper angle at which the glass must be set for correction. But many patients can not determine with sufficient exactness the most distinct line, even when the accommodation is paralyzed, and then it becomes necessary for the physician to resort to other methods or to note the angle (by repeated trial), as marked on the graduated scale attached to the frame which gives the sharpest vision for distance. The slightest variation from the correct angle in high degrees of astigmatism will considerably affect the sharpness of vision.

ILLUSTRATIVE CASES FROM CLINICAL MEMORANDA.

CASE I. *Simple astigmatism.*

T. W., a law student, aged 22, called upon me (June 2d) ten days ago. *History:* Had trouble with his eyes for two or three years past, pain on reading any length of time, and dimness of vision. At first this was noticed only at night, and afterward both day and night. This gentleman visited me in September, 1873, on his way to college. He complained of weak eyes, and thought I might give him something to strengthen them. The eyes were not inflamed, and I at once suspected an error of refraction. Upon trial, we found that neither weak concave nor convex spherical glasses improved his vision; weak cylindrical glasses were but little better. I suggested an examination with the ophthalmoscope. He was, however, in a great hurry and left without further examination, promising to return the same day, if his engagements would permit.

He did not return, as he was anxious to have the company of a young friend to college, who could not wait. During the succeeding year he suffered considerably with his eyes, and his studies were on this account much interrupted. He finally consulted an oculist, who suspected astigmatism and made the attempt to prove the degree, but owing to the fact that both weak and strong spherical glasses did not materially improve vision even when held in front of a stenopæic slit, the physician concluded that rest and blue or smoked glasses would be the proper treatment for him. Under his advice Mr. W. refrained from resuming his place at college for the next session. For the past year he has faithfully obeyed instructions, abstaining from reading as much as it was possible for him to do; he has been having a friend to read to him daily in order to save his eyes. He still has considerable ir-

ritability in both eyes, and they are very sensitive to strong light, although not inflamed.

With this brief history we will proceed to give from the notes of this case our plan of investigation. At 15′ (feet) the vertical bars and those at a slight angle from the vertical, upon Becker's plate, were distinct, while those perpendicular to them were dim. At 20′ he reads with the left eye the fourth line from the bottom of Snellen's test types. The letters, however, are distorted. In the left eye we therefore record S. (sight) $= \frac{2}{5}\frac{0}{0} =$ 2-5ths, $\frac{2}{2}\frac{0}{0}$ being considered normal vision.

At the same distance, he reads with the right eye, the third line from the bottom. Therefore, of this eye S. $= \frac{2}{4}\frac{0}{0} = \frac{1}{2}$. Concave and convex spherical glasses were now tried before each eye. A concave lens of 36″ focus improved vision slightly, but stronger concaves diminished it; with convex glasses he could see nothing.

The stenopæic apparatus was now tried with the slit in the diaphragm horizontal; he could now read the second line from the bottom of the test type. With the slit vertical, his sight was not nearly so good as without it; — 36″ was given him to hold in front of the slit, and he was requested to turn them together slowly before the eye until the best point was found. This, at the proper angle, improved vision, but stronger glasses revolved in the same way made no improvement. Our patient now complained of fatigue of that eye, and proposed to change the examination to the other. From the extreme sensitiveness of this eye, we feared a complication with disease of the retina or optic nerve, and decided before going further with our test-glasses to make an *ophthalmoscopic examination*. By this means we found that the optic discs of both eyes were hyperæmic; the left much more so than the right. By the erect image the blood-vessels running vertically were distinct, the horizontal vessels small and not easily discerned. The optic disc was elongated vertically. I may say here that I am aware that "Dr. Hays shows that this is not uniformly true," and has demonstrated that the elongations of the optic disc in the vertical or horizontal direction is not a proof of astigmatism, but is the result of the distance at which the object lens is held from the eye.*

I am prepared to admit the truth of the latter part of the above statement; but in cases of astigmatism I have observed a distortion

* Transactions American Ophthalmological Society, 1870, p. 86.

of the disc when the field was accurately in focus, and that this is not due to slight regular astigmatism in my own eyes, is proved by the fact that no such distortion is observed in the examination of normal eyes, provided the field is plainly in focus. But to return to our patient. The ophthalmoscopic examination did not reveal any sufficient cause for amblyopia, but confirmed the correctness of my diagnosis, that the source of the defect in vision was due to astigmatism. In order to get rid of any error which might have been produced by the active accommodation of the eye, we dilated the pupil with a strong solution of atropia sul. The stenopæic slit was now held horizontally before the left eye, and his vision rose to $\frac{2}{4}\frac{0}{0} = \frac{1}{2}$. A concave lens of 12-inch focus was held in front of the vertical slit, which greatly improved his sight. He could now read the second line from the bottom, S. $= \frac{2}{3}\frac{0}{0}$. With a concave glass of 7″ focus his vision was best. This glass, axis nearly horizontal, corrected the astigmatism. All the bars upon Becker's plate were equally bright, and he read with ease No. 30 of the test type at twenty feet; $-\frac{1}{6}\frac{}{0}$ S. added, made the type blacker, butdid not enable him to read the lowest line; $-\frac{1}{7}\frac{}{2}$ S. was better. We had now proved a high degree of myopia in the vertical meridian of the left eye, with so small amount in the horizontal meridian as to make it practically of little account. The examination of the right eye was now simplified, as we found that with the same glass—7″ C. axes horizontal, his vision rose to $\frac{2}{2}\frac{0}{0}$ nearly. Spherical minus and plus glasses added were no improvement. We therefore recorded myopia in the vertical meridian of the right eye $= \frac{1}{7}$, and in the horizontal meridian, emetropia (*i. e.* normal refraction.)

Concave cylindrical glasses of 7″ focus were ordered for both eyes. With these he sees in good illumination No. 20 of Snellen's type at 20′ (feet), and can read with the same glasses 1½ Snellen at 12 inches. He was, of course, delighted that he had found a remedy for his trouble, and that he could resume his studies without the fear of doing serious injury to his eyes.

The above may be considered an illustrative case for thousands of others.

CASE II. *Compound myopic astigmatism.* June 2d, the same day as the case just mentioned, Dr. L. B. consulted me for a defect in the vision of both eyes. History: Age 38, married; seven or eight years ago first noticed trouble with my eyes; was not able to see small objects distinctly; noticed that letters were distorted, and

straight vertical lines were curved; lamps were sometimes seen double, and the outlines of small objects were hazy; the left eye often became inflamed and painful; some five or six years since he consulted an eye-specialist, who made several examinations, but did not suggest a remedy for his trouble.

Astigmatism in this case was probably overlooked by the doctor, as it has been frequently by other reputable men.

Upon an examination, we found for the left eye in the horizontal meridian myopia of $\frac{1}{24}$; in the vertical meridian, myopia of $\frac{1}{6}\frac{1}{0}$. We therefore had, for the whole eye, myophia $= \frac{1}{6}\frac{1}{0}$ + A. M. $\frac{1}{8}\frac{1}{6}$. In the right eye, we found myophia of $\frac{1}{6}\frac{1}{0}$ + A. M. $\frac{1}{6}\frac{1}{0}$. For the left eye, with a concave cylindrical lens of $\frac{1}{3}\frac{1}{6}''$, combined with a spherical concave glass of $\frac{1}{6}\frac{1}{0}''$, his sight for distance was $\frac{2}{2}\frac{0}{0}$ (normal version). For the right eye, $-\frac{1}{6}\frac{1}{0}''$ C. and $-\frac{1}{6}\frac{1}{0}''$ S. combined, gave him normal sight. For reading at twelve to eighteen inches, he could see best with C. glasses, uncombined. As he did not wish to get two pair, we ordered the latter for both purposes. We have in the above case the evidence that even slight degrees of astigmatism often seriously disturbs vision. This gentleman was enthusiastic over the benefits derived by the glasses, and was impatient at the delay necessary to have the glasses ground and set in frames by the optician. He said that the proper diagnosis of his case had removed the apprehension of future blindness—a calamity great enough in itself, but the more fearful to him on account of his large family, who were entirely dependent upon him for support.

CASE III. *Simple hypermetropic astigmatism.* (Hypermetropia in one meridian, and emetropia—normal vision—in the other.) J. J. applied to me in June, 1874; his history was not taken, but my notes show that his vision for both eyes was $\frac{2}{5}\frac{0}{0} = \frac{2}{5}$, and with convex cylindrical glasses of 36″ focus, sight in each eye rose to normal vision.

We have heretofore stated in this paper that astigmatism was generally congenital; it is also often hereditary, and may occur in several members of the same family.

CASE IV. In July, 1874, Mr. E. B., editor, applied to me for advice about his eyes; had suffered with them from boyhood; he could not read long without closing one eye; the right was his best eye; had tried a variety of spectacles without benefit. An examination revealed simple myopic astigmatism in the right eye, and compound myopic astigmatism in the left. In this case, as in

several others, we found that fitting both eyes with plano-cylindrical glasses was preferable to giving one eye this sort of glass for correction of the simple astigmatism, and a spherico-cylindrical glass for the other eye affected with the compound form. With his reading-glasses, which we prescribed, he could read the smallest type of Snellen at twelve inches, and could see also very well with the same glasses for distance.

CASE V. *Astigmatism complicated with lamellar cataracts.* Mr. C. B., brother of the gentleman whose case we have just given above, visited me in July, 1874. He had been informed that he would be blind in a few months, and that there was no help for him, to use his own language. He was consequently much dejected, and came in fear and trembling to ask my opinion of his case. He had made up his mind to submit with what resignation he could to his fate. When his brother had been fitted with glasses, he concluded to seek further advice. He was a type-setter in the office of his brother, but had been compelled to give up work on account of his failing vision. *History:* At ten years of age he had convulsions, and since that time his vision has been imperfect. He often had a sense of fatigue about the eyes. The outlines of objects were hazy and indistinct. For the last six months his sight had failed considerably, and for the last month he has not been able to set fine type. The eyes were not inflamed; and, as he was still a young man (about twenty-four years of age), I did not suspect cataract, but thought the case to be either an error of refraction or amblyopia. Convex and concave spherical glasses made the sight worse. He reads two and a half Snellen at six inches, and three and a half at eighteen inches; the near point for the same type was five inches.

With the stenopæic apparatus, armed with convex spherical glasses, we found in the vertical principal meridian, hypermetropia of $\frac{1}{16}$; in the horizontal principal meridian H. of $\frac{1}{32}$. This would give us H. $\frac{1}{32}$ + A. H. $\frac{1}{20}$ nearly. The degree was about the same in each eye; and he should have received ordinarily a convex spherical glass of $\frac{1}{32}''$, combined with a $\frac{1}{20}''$ C. In fact, however, he could see best with each eye when armed with $\frac{1}{16}''$ C. glasses. We now examined the eye with the ophthalmoscope, and then discovered the lamellar or zonular opacity in the crystalline lens of both eyes. The fundus of the eye could be plainly discerned, and its details quite accurately made out. Without glasses,

his sight for distance was $\frac{2}{5}\frac{0}{0} = \frac{2}{5}$ for each eye. With the cylindrical glasses, his sight was $\frac{2}{3}\frac{0}{0}$ or $\frac{2}{3}$. He was furnished with these glasses, and informed that as long as the opacity did not extend toward the periphery of the lens, his sight would remain good in all probability by the aid of his glasses, but we could give him no positive assurance that the cataracts might not be further developed, thereby shutting off all practical vision. In the above case, abnormal regular, as well as irregular astigmatism, caused by a change in the structure of the crystalline lens, probably exceeded regular astigmatism of the cornea. As lamellar cataracts are either stationary or slowly progressive, it will be a great benefit conferred upon persons thus afflicted if we can even for a few months restore useful vision, before resorting to iridectomy, iridodesis, or an operation for the extraction of the cataracts. While many, provided it be found that abnormal astigmatism generally exists in these cases, may be able to wear the glasses with benefit for a lifetime. As far as I can find, the experiment of using cylindrical glasses for the improvement of vision in cases having lamellar or zonular cataracts, is entirely new.

Mixed Astigmatism.—In this form we have myopia in one principal meridian and hypermetropia in the other.

CASE VI. M. B., a sister of charity, was fitted by me some three or four years ago with cylindrical glasses, which at the time vastly improved her vision. Owing to some accident to the glasses, she came to be refitted in August, 1874. From my notes, I find that she had often had much trouble with her eyes before she got her glasses; her eyes at times had been inflamed, and she had from childhood great difficulty in seeing clearly. In reading, the letters run together, and she had acquired the habit of holding the book very close to get rid of the diffuse and hazy outlines of the letters. By methods already stated, we found in the left eye, in the vertical principal meridian, myopia of $\frac{1}{2}\frac{0}{0}$, and in the horizontal meridian, hypermetropia of $\frac{1}{1}\frac{0}{6}$, and for the right eye, myopia in the vertical of $\frac{1}{3}\frac{0}{0}$, and in the horizontal, hypermetropia of $\frac{1}{1}\frac{0}{8}$. Bi-cylindrical glasses were therefore ordered, the axis of the concave cylinder to correspond with the hypermetropic meridian, and the axis of the convex cylindrical lens to be in the plane of the vertical or myophic meridian, the axis of both glasses to be set at right angles. Without the glasses for R. E., S. $= \frac{2}{7}\frac{0}{0} = \frac{2}{7}$; and in the L. E., S. $= \frac{2}{2}\frac{0}{0}\frac{0}{0} = \frac{1}{2}\frac{0}{6}$. Now this eye was evidently amblyopic. With the crossed C. lenses

for R. E., S. $= \frac{2}{20}$ nearly; for L. E., S. $= \frac{2}{40} = \frac{1}{2}$. She could also read the finest of Snellen's test type, at twelve inches, using both eyes.

If I have been somewhat tedious to the eye-specialist in my relation of cases, I hope that the object of my paper—viz., to call attention to this important and interesting subject, and to induce among the *general profession* further investigation and increased knowledge of an anomaly in refraction, which can not be relieved by the glasses ordinarily to be found at opticians—will excuse what may otherwise appear as unnecessary minuteness of detail.

Any lover of art who has visited the national gallery at London, must have been astonished with the difference between the earlier paintings of Turner, the great English landscape painter, and those executed by him later in life. The latter have the appearance of having been done in a hurry, presenting a vagueness in outline, and a confusion of detail inexplicable to all who do not understand the secret of this wonderful decline in conception or skill in execution of the works of the great artist. Some persons have attributed the change to the effects of a diseased mental and physical condition, and others not so charitable, said the eminent painter had become avaricious and used both cheap paints and indiscreet haste in his work. But Liebreich, the distinguished oculist to St. Thomas' Hospital, London, stated in a lecture, at which I was present, that it was quite evident to him that Turner's eyes had become impaired in vision by reason of astigmatism. Had the discovery of Dr. Young been properly appreciated, the lustre of Turner's fame might have remained untarnished, and probably his last efforts would have been his greatest and best works.

Within the last two centuries, the improvements made in astronomical instruments have enabled astronomers to discover new worlds, to fix the orbits of planets—nay, more, to look into those worlds, see mountains, and by means of spectrum analysis to ascertain even the composition of their atmospheres. Yet for ages, the wonderful organ which enabled us to learn something of the planetary system located in space millions of miles from our earth, was comparatively little understood. When Galileo at Padua, in 1609, constructed his first telescope "with a lead tube and two spectacle glasses," he in triumph hurried with it to Venice, where the "magical toy" excited the greatest enthusiasm. At the request of the doge, he presented his extraordinary instrument to the senate, who rewarded him by "conferring upon him for life his professorship at Padua, and generously raising his salary from 520

to 1,000 florins."* The discovery and practical demonstration of the anomaly in refraction since called astigmatism, conferred as great a boon upon mankind in my opinion as the invention of a telescope by Galileo. Parliament did not vote Dr. Young an annuity, however, nor even give recognition to his brilliant discovery.